DOCUMENT RESUME

ED 277 852 CE 046 079

AUTHOR Anderson, B. Harold; And Others
TITLE Assessing the Effect of Increased High School Graduation Requirements and the Development of Models to Minimize the Impact on Enrollments in Vocational Courses. Research Report. Executive Summary.
INSTITUTION Colorado State Univ., Ft. Collins.
SPONS AGENCY Colorado State Board for Community Colleges and Occupational Education, Denver.
PUB DATE Dec 86
NOTE 41p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Academic Standards; Change Strategies; *Credits; *Enrollment Influences; *Graduation Requirements; High Schools; Mathematics Curriculum; Models; *Required Courses; Science Curriculum; State Standards; *Statewide Planning; *Vocational Education
IDENTIFIERS *Colorado; Impact Studies

ABSTRACT

A research project was undertaken to analyze the effect of increased science and math high school graduation requirements and to develop models to minimize the impact of these increases on vocational course enrollments. Data from survey instruments sent to Colorado's 174 school districts, state directors of vocational education, and state curriculum directors indicated that, like the rest of the nation, Colorado does appear to be increasing its high school graduation requirements. Although no definite decrease in enrollments was evident in the data collected for the year studied, there did appear to be a decrease in vocational enrollments and the number of vocational courses offered in the larger districts. Despite the limited objective data, there did appear to be a correlation between the increase in academic units required for graduation and the dropout rate in vocational programs. Schools were developing alternative methods to enable students to meet the academic requirements for high school graduation without reducing their time in vocational courses. The alternatives emerging from the study included granting direct credit for vocational courses, awarding shared credit (half academic and half vocational), using competency testing in lieu of credits required, and requesting district-level policy changes to reduce established credit requirements based on such criteria as coded skills and demonstrated occupational needs. (Appendixes include a list of advisory committee members, the three project survey instruments, 15 tables summarizing the study findings, and suggested alternative models for setting science and math requirements.) (MN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED277852

RESEARCH REPORT

Executive Summary

ASSESSING THE EFFECT OF INCREASED HIGH SCHOOL GRADUATION REQUIREMENTS AND THE DEVELOPMENT OF MODELS TO MINIMIZE THE IMPACT ON ENROLLMENTS IN VOCATIONAL COURSES

By

Dr. B. Harold Anderson, Project Director
Mr. Glyn Sharpe, Project Director
Ms. M. L. Cornette, Research Technician

Prepared for the Colorado Community College and Occupational Education System

December 1986

School of Occupational and Educational Studies
Colorado State University
Fort Collins, Colorado

CE046079

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

B Harold Anderson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

COLORADO STATE BOARD FOR COMMUNITY COLLEGES
AND OCCUPATIONAL EDUCATION

Mr. Raymond "Buzz" Wilder, Chairman
5th Congressional District

Ms. Jane S. Quimby, Vice Chair
3rd Congressional District

Mr. Rolf F. Anderson
Member at Large

Mr. Joseph H. Cline
4th Congressional District

Mr. Jay L. Fox
6th Congressional District

Mr. Lawrence E. Hamilton
1st Congressional District

Ms. Myra H. Monfort
Member at Large

Ms. Anita L. Sanchez
2nd Congressional District

Mr. H. Clay Whitlow
Member at Large

Dr. Jerry Wartgow, System President

Ms. Dorothy Horrell, Vice President for Educational Services

Dr. Carole Johnson, Director of Planning and Research

TABLE OF CONTENTS

Page

Introduction 1

Objectives 2

Procedures 3

Findings 4

Implications 7

Recommendations 7

Appendices 9

Appendix A—Advisory Committee Members 10

Appendix B—High School Graduation Requirements Survey Instrument 12

Appendix C—State Graduation Requirement Survey Instrument 15

Appendix D—State Requirements and Standards for Science and Math Survey Instrument 17

Appendix E—Tables of Findings 19

Table 1. Alternative Methods Utilized by Colorado School Districts to Meet Academic Requirements 20

Table 2. Units Required for Graduation From Colorado High Schools 20

Table 3. Enrollments in Vocational Courses in Colorado High Schools 21

Table 4. Total Number of Vocational Courses Offered 21

Table 5. Student Demand for Vocational Courses 21

Table 6. Use of Elective Courses to Meet High School Graduation Requirements 22

Table 7. High School Drop Out Rate 22

Table 8. Academic Units Required for Graduation in States Other Than Colorado 22

Table 9. Enrollments in Vocational Courses in States Other Than Colorado 23

Table 10. Summary of the States on Science and Mathematics Requirements 24

Table 11. State Course Requirements in Science and Mathematics 25

Table 12. Suggested Essential Skills for Science (9-12) 26

Table 13. Suggested Essential Mathematics Skills (9-12) 27

Table 14. Coding by Vocational Area to Essential Science Skills in Colorado 28

Table 15. Coding by Vocational Area to Essential Mathematical Skills 29

Appendix F—Suggested Alternative Models 30

INTRODUCTION

Beginning in 1984 with the publishing of numerous reports calling for change, public education has experienced a reform movement. The central theme of this movement has been the "strengthening" of the academic units required for high school graduation. From the beginning many educators expressed concern about the affect this movement may have on the high school drop out rate and enrollments in elective courses such as vocational education. In February of 1985, Anderson[1] completed a study which showed that the drop out rate and vocational enrollments were negatively impacted by increasing the academic units required for graduation from high school.

Staff members from the Colorado Community College and Occupational Education System (CCCOES) recognized that this area needed additional study and distributed a request for proposal in the spring of 1986. Two of the proposals submitted with different projected outcomes were determined to have merit. Rather than limit the research to one or the other it was agreed to combine the concepts into one project. The study, with the two phases, is reported in this summary. Phase one of the study dealt with gathering additional information on the effects of increasing graduation requirements while phase two dealt with science and math competencies and the identification of alternative models for meeting high school graduation requirements. This summary is organized to present the procedures and findings for each phase.

The project directors wish to express their appreciation to the CCCOES staff and advisory committee members (Appendix A) for their assistance in designing and conducting the study. The cooperation of those individuals in the school districts of Colorado who responded to the survey instrument, the state directors of vocational education and state curriculum specialists who provided valuable information on trends on other states is sincerely appreciated. The cooperation and help of the state supervisors of science and mathematics were instrumental in giving a complete national summary of the requirements in science and mathematics. This cooperation was sincerely appreciated by the study directors.

A special thanks goes to M. L. Cornette, research technician, for her help in collecting and analyzing the data and to Carol Mathena for supervising the production and editing of the manuscript.

---

1 Anderson, B. Harold "The Effects of Increased Academic Requirements for Graduation on Secondary Vocational Enrollments in Colorado." Department of Vocational Education, Colorado State University, February, 1986.

OBJECTIVES

This study was designed with the following objectives:

PHASE ONE

1. To determine whether the total units required for graduation were increasing or decreasing in the school districts of Colorado.

2. To determine whether enrollment in vocational courses was increasing or decreasing in the school districts in Colorado.

3. To determine whether the total number of vocational courses offered was increasing or decreasing in the school districts of Colorado.

4. To determine whether student demand for vocational courses was increasing or decreasing in the school districts of Colorado.

5. To determine whether the number of elective courses that can be utilized to meet minimum requirements was increasing or decreasing in the school districts in Colorado.

6. To determine whether the high school drop out rate was increasing or decreasing in the school districts in Colorado.

7. To determine the nature and extent to which Colorado school districts were utilizing alternative methods to meet high school graduation requirements.

8. To determine whether the total units required for high school graduation were increasing or decreasing in states other than Colorado.

9. To determine whether enrollment in vocational courses was increasing or decreasing in states other than Colorado.

10. To identify alternative methods or exemplary programs that were being utilized to meet high school graduation requirements in states other than Colorado.

PHASE TWO

1. To review literature concerning science and mathematics competencies and requirements for graduation from high school.

2. To survey state science and mathematics supervisors to determine the number of science and mathematics courses mandated by the states for high school graduation.

3. To develop a suggested list of essential skills in both science and math.

4. To develop criterion tests in science and mathematics that could be used to measure the essential skills.

5. To code several occupational courses to the essential skills in science and mathematics.

6. To develop models that offer alternative options to schools in lieu of adding additional requirements in science and mathematics.

7. To make recommendations to the CCCOES for possible follow-up with local districts to minimize the adverse effects of increased courses in science and mathematics.

8. To suggest a plan of action for the CCCOES concerning the findings and recommendations of the study.

9. To identify exemplary programs in Colorado schools that have enabled them to successfully maintain or increase enrollments in vocational programs.

PROCEDURES

The following procedures were utilized in conducting this study:

PHASE ONE

1. An advisory committee (Appendix A) was formed to review the overall procedures and provide direction on the development of the data gathering instruments.

2. A data gathering instrument (Appendix B) was developed and sent to each school district in Colorado. The first page of the instrument was utilized to obtain the specific graduation requirements of each school district for the State Department of Education's biennial survey of graduation requirements. The data from this portion appears in a report prepared by the State Department of Education.

3. A survey instrument (Appendix C) was developed and sent to each state director of vocational education and the person designated to be in charge of curriculum in each State Department of Education.

4. Follow-up phone calls were made to all school districts in Colorado who had not returned the questionnaire by September 1, 1986. No follow-up procedures were utilized to obtain additional responses from the state directors of vocational education or state curriculum directors since an adequate response was obtained with the initial mailing.

5. No additional follow-up attempts were made after October 15, 1986. The data obtained as of that date became the basis for the findings and recommendations reported in this study. Of the 174 school districts in Colorado that were sent questionnaires, 166 or 95.4 percent responded. Sixty-three percent of the state directors of vocational education and 68 percent of the curriculum directors responded to the survey.

6. The data from the questionnaires was summarized and analyzed utilizing frequency counts and percentages.

PHASE TWO

1. A review of the current literature was made.

2. A questionnaire was developed to survey the state science and mathematics supervisors. The responses were summarized and compared with results in 1984 that were assessed by the Education Commission of the States. The instrument in shown in Appendix D.

3. Curriculum guides from the states were studied to determine which science and mathematics skills were common to most. Several standardized tests were studied as another criteria to help determine what skills were either studied or were tested by great numbers of educators. The skills in science and mathematics that were included in most of these documents were identified and listed as essential skills and were used to generate test items and also for course codings.

4. Thirteen occupational courses were used to illustrate how the list of suggested skills can be coded to show how these skills are applied in the instruction of that vocational course.

5. Models were developed from an analysis of the findings, interviews with vocational educators and high school principals, and suggestions from a study of the literature.

6. Recommendations were made based on the survey results, developed products, and what seems to be needs and demands from local school districts.

7. A suggested plan of action was developed for possible follow-up by CCCOES.

FINDINGS

The major findings of this study include:

PHASE ONE

1. Over one third or 36 percent of the school districts in Colorado reported it was possible for students to utilize alternative methods to meet high school graduation requirements. See Table 1 of Appendix E for a listing of alternatives.

2. The majority, or 71 percent of the school districts in Colorado reported no change in the total units required for graduation during the 1985-86 school year while 26 percent reported an increase and 3 percent reported a decrease in the total units required. See Table 2 of Appendix E for a comparison with the 1984-85 school year.

3. Enrollments in vocational courses increased during the 1985-86 school year in 25 percent of the Colorado school districts while 23 percent of the districts reported a decrease. A comparison with the 1984-85 school year can be made by reviewing Table 3 of Appendix E.

4. Twenty percent of the school districts in Colorado reported an increase in the total number of vocational courses offered during the 1985-86 school year while 11 percent reported a decrease. A comparison with the 1984-85 school year is shown in Table 4 of Appendix E.

5. Student demand for vocational courses increased in 24 percent of the Colorado school districts during the 1985-86 school year while 21 percent of the districts reported a decrease. A comparison with the 1984-85 school year is shown in Table 5 of Appendix E.

6. The number of elective courses that can be utilized to meet minimum graduation requirements increased in 21 percent of the Colorado school districts while 14 percent reported a decrease. A comparison with the 1984-85 school year is shown in Table 6 of Appendix E.

7. The high school drop out rate decreased in 19 percent of the Colorado school districts during the 1985-86 school year while 13 percent reported an increase. During the 1984-85 school year, 14 percent of the districts reported a decrease in drop out rate while 5 percent reported an increase. Table 7 of Appendix E provides a more complete breakdown of the drop out rates reported.

8. Four percent of the Colorado school districts reported utilizing competency tests to determine minimum competencies in science, math, language arts, and other areas required for graduation in lieu of completing a specific number of courses in each of these areas.

9. Eleven percent of the school districts in Colorado required competency testing as a requirement for graduation in addition to completing minimum course requirements.

10. Twenty-one percent of the Colorado school districts reported that concern had been expressed by school board members or high school administrators and faculty about changing their present graduation requirements to reduce the difficulty for students to enroll in vocational education or other elective courses.

11. Six percent of the districts in Colorado reported that concern had been expressed by school board members or high school administrators and faculty over barriers they perceive might inhibit the utilization of alternative methods of granting or waiving credit to meet specific academic course requirements for high school graduation.

12. Two percent of the school districts reported that they had objective data to support the belief that increasing graduation requirements increases drop out rates.

13. An increase in the academic units required for graduation in their state was reported by 92 percent in the state directors of vocational education and 88 percent of the state department curriculum directors. A decrease was reported by three percent of the state directors of vocational education and none of the state curriculum directors. A detailed comparison can be gained by reviewing Table 8 of Appendix E.

14. Enrollment in vocational courses in their state was reported to be decreasing by 75 percent of the state curriculum directors and 63 percent of the state directors of vocational education. See Table 9 of Appendix E for a detailed comparison.

PHASE TWO

A review of the literature and the survey of the state supervisors of science and mathematics highlighted the feelings and commitment of the general public and many educators to be as follows:

1. School improvement in science and mathematics has been targeted as a high priority.

2. Utilizing additional courses is the methodology most widely used to accomplish this priority.

3. Most of the states increased course requirements in science and mathematics prior to 1984. The situation in 1986 is static for the most part. See Table 10 of Appendix E for a summary of state science and math requirements.

4. The present trend to increase course requirements is coming from the local school district level. This is certainly the case in Colorado where there are no state mandated courses required. See Table 11 of Appendix E for a summary of each state's requirement.

5. The additional courses in science and math that have been required are geared toward the college bound student rather than meeting the needs of those students who would benefit from an applied approach.

6. There is sufficient consistency among the various tests utilized to test science skills to identify the essential skills in science. See Table 12 of Appendix E for a listing of these skills.

7. There is sufficient consistency among various tests utilized to test mathematical skills to identify the essential skills in mathematics. See Table 13 of Appendix E for a listing of these skills.

8. A number of essential science skills are taught in vocational education courses. See Table 14 of Appendix E for a listing of these skills by vocational program area.

9. A number of essential mathematic skills are taught in vocational education courses. See Table 15 of Appendix E for a listing of these skills by program area.

10. A number of options are available to local school districts to enable students to meet the minimum requirements for science and mathematics other than enrolling in the prescribed minimum number of courses in this area. See Appendix F for a list of suggested models.

IMPLICATIONS

Based on the findings of this study, the following implications can be drawn:

1. The increase in academic units required for high school graduation appears to be a national trend.

2. Enrollment in vocational courses appears to be adversely affected by an increase in the academic units required for graduation.

3. Enrollment and student demand for vocational education courses in Colorado during the 1985-86 school year showed no specific trend since the number of districts reporting a decrease was almost equal to those reporting an increase. However, it appears that the decrease in vocational enrollments and number of vocational courses offered is more prevalent in the larger school districts.

4. Although objective data is limited, there appears to be a correlation between the increase in academic units required for high school graduation and the drop out rate.

5. There appears to be more concern being expressed by school personnel about the increasing of the academic requirements for high school graduation without thoroughly studying the adverse effects this change may bring about.

6. There is a definite trend among school districts to utilize alternative methods to enable students to meet the academic requirements for high school graduation.

7. There appears to be an increase in the utilization of competency tests in the basic academic areas as a requirement for high school graduation, and also for use in enabling students to meet the minimum graduation requirements in specific subject areas such as mathematics and science.

8. Public opinion, rather than state or federal mandated requirements, seems to be the change agent driving public schools toward increasing their academic requirements for high school graduation.

9. There appears to be a trend among some school districts to reexamine their actions taken to increase academic units required for graduation, and in some cases relax or reduce these requirements.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. School districts who have increased their academic requirements for high school graduation should conduct a thorough study on what effect this action has had on the high school dropout rate, enrollment in vocational education courses and other elective subjects.

2. School districts should expand the alternative methods students can utilize to meet minimum high school graduation requirements and still partake in elective courses.

3. School districts and state educational agencies should make a concerted effort to continue to identify exemplary models that enable students to meet high school graduation requirements utilizing alternative methods.

4. The results of this study should be make available to all Colorado school districts through regional or state meetings with particular attention being given to acquainting them with the lists of essential skills in mathematics and science and the models for using alternative methods for meeting high school graduation requirements.

5. The sample tests of essential skills in science and mathematics developed as a part of this study should be validated in pilot schools as soon as possible.

6. Information on high school graduation requirements, enrollments in vocational courses and high school dropout rates collected as a part of this study should be collected on an annual basis.

7. A concerted effort should be make to gain acceptance and support of the suggested essential skills in science and mathematics developed as a part of this study by the Colorado Department of Education, the CCCOES, school boards, school administrators, science and mathematics specialists and high school teachers.

8. A study should be conducted to determine why enrollments in vocational courses in some Colorado school districts are increasing while it is decreasing in others.

APPENDICES

APPENDIX A

ADVISORY COMMITTEE MEMBERS

ADVISORY COMMITTEE MEMBERS

	Representing
Mr. Larry Bradsby	Math Specialist
Dr. Boyd Dressler	Colorado Department of Education
Mr. Jack Hale	Secondary Administrator
Dr. Lonnie Hart	Local VocationalAdministrator
Dr. Carole Johnson	CCCOES
Dr. Dale McCall	State Council on Vocational Education
Mr. Tom McIntosh	Science Specialist

APPENDIX B

HIGH SCHOOL GRADUATION REQUIREMENTS SURVEY INSTRUMENT

Return to: B. Harold Anderson
Department of Vocational Education
Colorado State University
Fort Collins, CO 80523

1986-87 HIGH SCHOOL GRADUATION REQUIREMENTS SURVEY

School District_____ County_____
Number of High Schools in District_____
Typical Number of Class Periods in School Day_____
Typical Number of Hours in School Day_____
Person Preparing Report_____

Part One--Specific Requirements

Directions: When completing the information requested below regarding graduation requirements, please utilize the following guidelines.

1. List the requirements for the class that enters high school during the 1986-87 year.
2. If your district has three-year high schools, please include ninth grade requirements so that four years are shown in the totals.
3. If your district has more than one graduation track, list the general track or the track with the least requirements in math, science, English, and social studies.
4. Report all requirements in Carnegie units. One Carnegie unit is equal to one class meeting daily for the entire school year. (i.e. one Carnegie unit = 10 semester hours)
5. Use the back of this page to make comments or clarify your responses.
6. If you have questions concerning this portion of the survey contact Dr. Boyd Dressler at the Colorado Department of Education.

Subject Area	Carnegie Units Required
Mathematics	
Science	
English Literature	
English Composition	
Social Studies	
Physical Education	
Foreign Language	
Fine Arts (art, music, etc.)	
Vocational Education (reimbursed type programs)	
Practical Arts/Homemaking (indust. arts, non-reimbursed home ec.)	
*Health	
*Computer Literacy	
Other Required Courses (list)_____	
_____	
_____	
Electives	
TOTAL NUMBER OF UNITS REQUIRED	

*If health or computer literacy are included in other listed subjects, please indicate the subject and approximate units or fraction of units required below.

Health: other subject_____ units_____

Computer Literacy: other subject_____ units_____

List any other requirements students in your district must meet to graduate (attend at least 8 semesters, enroll in at least 4 classes per term, etc.)

Part Two--Alternative Methods

Is it possible for students in your district to meet the minimum requirements for graduation by using alternative methods rather than meeting the specific minimum course requirements in math, science, English, etc.? ___YES ___NO

The chart below lists alternative methods that can be utilized to enable students to meet minimum graduation requirement. Please place a check (✓) in the appropriate box indicating whether a student is actually granted credit, the requirement is waived, or the credit is shared for those alternative methods used in your district.

Alternative Method	Granting Credit	Waiver of Requirement	Sharing Credit
Competency Testing			
Using Vocational Courses for a Portion of Science or Math Requirement			
Summer Course Offerings			
Offering Classes Outside the Regular School Hours			
Using Other Courses to Substitute Requirements in Specific Academic Areas			
Testing Out			
Increasing the Number of Periods per School Day			

Please list any alternative methods or procedures that your school district is using to increase options or flexibility in the curriculum.

_____

_____

_____

Part Three--Trends

Directions: Place the appropriate number from the scale below in each box in the chart as it relates to trends in enrollment and requirements in your district during the last two years.

SCALE: 0 = decreased
1 = remained the same
2 = increased

FACTOR	1984-85 SCHOOL YEAR	1985-86 SCHOOL YEAR
Total units required for graduation	_____	_____
Enrollment in vocational courses	_____	_____
Total number of vocational classes offered	_____	_____
Student demand for vocational courses	_____	_____
Number of elective courses that can be utilized to meet minimum graduation requirements	_____	_____
High school drop-out rate	_____	_____

As an alternative for some students, does your school district utilize competency testing to determine whether they possess the minimum competencies in science, math, language arts and other areas required for graduation in lieu of completing a specific number of courses in each of these areas? ___YES ___NO If yes, please indicate what tests are used_____

Does your school district utilize any form of competency testing as a requirement for graduation in addition to completing minimum course requirements? ___YES ___NO If yes, please indicate what tests are used. _____

_____

Has concern been expressed by your school board or high school administrators and faculty to bring about discussion or consideration of changing present graduation requirements to reduce the difficulty for students to enroll in vocational or other elective courses? ___YES ___NO

Has concern been expressed by your school board or high school administrators and faculty over barriers they perceive might inhibit the utilization of alternative methods of granting or waiving credit to meet specific academic course requirement for high school graduation? ___YES ___NO If yes, please identify these barriers. _____

_____

_____

Do you have any objective data to support the belief that increasing graduation requirements increases drop-out rates? ___YES ___NO If yes, would you be willing to share this data on a follow-up call? ___YES ___NO

APPENDIX C

STATE GRADUATION REQUIREMENTS SURVEY INSTRUMENT

STATE GRADUATION REQUIREMENTS SURVEY

Name of person completing report_____ State_____

1. During the last two years what has been the trend in your state's high schools regarding the number of academic units required for graduation? (check one)

   _____Increasing _____Decreasing _____Remaining the same

2. In those high schools in your state that have increased academic requirements for graduation, what has been the resulting enrollment trend in vocational courses?

   _____Increasing _____Decreasing _____Remaining the same

3. Listed below are some of the alternative ways to allow students to enroll in vocational or other elective courses and still meet the increased academic requirements for graduation. Please check those which are being utilized by high schools in your state.

   Alternatives: (check those that apply)

   _____Using vocational courses for a portion of science or math requirement

   _____Competency testing

   _____Summer course offerings

   _____Offering classes outside the regular school hours

   _____Using other courses to substitute requirements in specific academic areas

   _____Testing out

   _____Increasing the number of periods per school day

   _____Others (list) _____

4. Please list any studies that have been conducted in your state to determine the effects of increased graduation requirements on vocational education enrollment or dropout rates.

STUDY	SOURCE

5. Please identify any exemplary programs that have been initiated in your state to provide alternative ways of enabling students to meet the academic requirements for high school graduation while enrolled in vocational education courses.

   _____

   May we contact you or someone else you identify by phone for more specific information on these programs? _____YES _____NO If yes, who may we contact?

   Name_____ Phone no._____

I would like a summary of the findings of this study _____YES _____NO

WHEN COMPLETED, PLACE IN SELF-ADDRESSED STAMPED ENVELOPE FOR RETURN

APPENDIX D

STATE REQUIREMENTS AND STANDARDS FOR MATHEMATICS SURVEY INSTRUMENT

STATE REQUIREMENTS AND STANDARDS
FOR MATHEMATICS*

STATE_____

REPORTER_____

ADDRESS_____

_____

_____

TELEPHONE_____

Please check the appropriate space that applies to your state:

1. Mathematics requirements for high school graduation that are state mandated are: a.____none, b.____one year, c.____two years, d.____three years or e.____four years.

2. Does your state require students to pass a statewide mathematics test as part of the graduation requirements? a.____yes or b.____no

3. Graduation requirements in mathematics, if any, are met by: a.____courses completed, b.____competency testing statewide, c.____competency testing local or d.____teacher verification or judgment.

4. Can other programs that apply mathematics like some vocational courses be used to meet one or more of the mathematics requirements? a.____yes or b.____no. If yes, which of the following are used?

   a.____Other area courses are substituted for a mathematics requirement.

   b.____Credit is partially shared between mathematics and the other area.

   c.____Other (please specify)_____

5. Has your state increased the mathematics requirements in the past three years? a.____yes or b.____no.

6. Does your state have essential skills for high school graduation? a.____yes or b.____no

7. A summary of this survey is requested. a.____yes or b.____no.

* The science questionnaire contained identical questions

APPENDIX E

TABLES OF FINDINGS

Table 1. ALTERNATIVE METHODS UTILIZED BY COLORADO SCHOOL DISTRICTS TO MEET ACADEMIC REQUIREMENTS

Method	Percent
Summer Offerings	32
Classes Outside Regular School Hours	27
Using Vocational Courses	11
Testing Out	5
Competency Testing	5
Increasing Number of School Periods Per Day	5

Table 2. TOTAL UNITS REQUIRED FOR GRADUATION FROM COLORADO HIGH SCHOOLS

Total Units	Percent	
	1984-85	1985-86
Increased	14	26
Decreased	0	3
Remained the Same	86	71

Table 3. ENROLLMENTS IN VOCATIONAL COURSES IN COLORADO HIGH SCHOOLS

Enrollment	Percent	
	1984-85	1985-86
Increased	12	25
Decreased	19	23
Remained the Same	69	52

Table 4. TOTAL NUMBER OF VOCATIONAL COURSES OFFERED

Courses Offered	Percent	
	1984-85	1985-86
Increased	8	20
Decreased	6	11
Remained the Same	86	69

Table 5. STUDENT DEMAND FOR VOCATIONAL COURSES

Demand	Percent	
	1984-85	1985-86
Increased	9	24
Decreased	15	21
Remained the Same	76	55

Table 6. USE OF ELECTIVE COURSES TO MEET HIGH SCHOOL GRADUATION REQUIREMENTS

Use	Percent	
	1984-85	1985-86
Increase	8	21
Decrease	8	14
Remained the Same	84	65

Table 7. HIGH SCHOOL DROP OUT RATE

Rate	Percent	
	1984-85	1985-86
Increased	5	13
Decreased	14	19
Remained the Same	81	68

Table 8. ACADEMIC UNITS REQUIRED FOR GRADUATION IN STATES OTHER THAN COLORADO

Units Required	Percent	
	State Vocational Director	State Curriculum Director
Increased	92	88
Decreased	3	0
Remained the Same	5	12

Table 9. ENROLLMENT IN VOCATIONAL COURSES IN STATES OTHER THAN COLORADO

Enrollment	Percent	
	State Vocational Directors	State Curriculum Directors
Increased	0	0
Decreased	63	75
Remained the Same	37	25

Table 10. SUMMARY OF THE STATES ON SCIENCE AND MATHEMATICS REQUIREMENTS[1]

AREA	YEARS REQUIRED				TESTING REQUIRED		REQUIREMENTS ARE MET BY:		OTHER COURSES SUBSTITUTED		TRENDS SINCE 1984		ESSENTIAL SKILLS ARE LISTED	
	3	2	1	0	Yes	No	Courses	Testing	Yes	No	Increase	Decrease	Yes	No
SCIENCE	5	30	8	7	4	46	40	2	14	31	4	1	16	34
MATHEMATICS	9	33	1	7	14	36	39	3	16	30	3	0	15	35

[1]The preceding comparison used the Education Commission of the States Report of minimum high school requirements completed in August, 1984 as the baseline data for the comparisons and trends. The 1986 data came from a survey of state science and mathematics supervisors. Several telephone calls were necessary to complete the all-state report. The results of the survey are summarized above.

SUMMARY:

1. Course requirements tend to be a little higher in mathematics than in science with 42 of the states requiring more than two courses for graduation.
2. Testing required for graduation is much higher in mathematics. A majority of the states do not require state testing.
3. Courses completed is the methodology required by most of the states to satisfy the requirements.
4. About one-third of the states will allow at least one course from other areas to satisfy science and mathematics requirements. There were several conditions listed in several cases.
5. A static situation exists as to increasing requirements at the present time. More than one-half of the states indicated that requirements had been increased during the three years prior to 1986.
6. About one-third of the states list essential skills for the two areas. The requirements are in place without a clear definition of what is expected from the students.

Table 11. STATE COURSE REQUIREMENTS IN SCIENCE AND MATHEMATICS

STATE	MATHEMATICS COMPARISON			SCIENCE COMPARISON		
	1984	1986	CHANGE	1984	1986	CHANGE
Alabama	2	2	0	1	2	+1
Alaska	2	2	0	2	2	0
Arizona	2	2	0	2	2	0
Arkansas	2 or 3	2 or 3	0	2 or 3	2 or 3	0
California	2	2	0	2	2	0
Colorado	0	0	0	0	0	0
Connecticut	3	3	0	2	2	0
Delaware	2	2	0	2	2	0
Florida	3	3	0	3	3	0
Georgia	2	2	0	2	2	0
Hawaii	2	2	0	2	2	0
Idaho	2	2	0	2	2	0
Illinois	2	2	0	1	1	0
Indiana	2	2	0	2	2	0
Iowa	0	0	0	0	0	0
Kansas	2	2	0	2	2	0
Kentucky	3	3	0	2	2	0
Louisiana	3	3	0	3	3	0
Maine	0	0	0	0	0	0
Maryland	2	2	0	2	2	0
Massachusetts	0	0	0	0	0	0
Michigan	0	0	0	0	0	0
Minnesota	1	1	0	1	1	0
Mississippi	1	2	+1	1	1	0
Missouri	2	2	0	2	2	0
Montana	2	2	0	1	1	0
Nebraska	0	0	0	0	0	0
Nevada	2	2	0	1	1	0
New Hampshire	2	2	0	2	2	0
New Jersey	2	2	0	1	1	0
New Mexicoo	2	2	0	1	2	+1
New York	1	2	+1	1	2	+1
North Carolina	2	2	0	2	2	0
North Dakota	2	2	0	2	2	0
Ohio	2	2	0	1	1	0
Oklahoma	2	2	0	2	2	0
Oregon	2	2	0	2	2	0
Pennsylvania	3	3	0	3	3	0
Rhode Island	1	2	+1	1	1	0
South Carolina	3	3	0	3	2	-1
South Dakota	2	2	0	2	2	0
Tennessee	2	2	0	2	2	0
Texas	3	3	0	2	2	0
Utah	2	2	0	2	2	0
Vermont	3	3	0	3	3	0
Virginia	2	2	0	2	2	0
Washington	2	2	0	2	2	0
West Virginia	2	2	0	1	2	+1
Wisconsin	2	2	0	2	2	0
Wyoming	0	0	0	0	0	0

Table 12. SUGGESTED ESSENTIAL SKILLS FOR SCIENCE (9-12)

SKILL	GA	FL	IL	MO	NH	KY	TAP	SRA	SAT	MAT	NAEP	INCLUSION
1. Describes Atomic Nature of Matter	X	X	X	X	X	X	X	X	X	X	X	11/11
2. Describes Forms of Energy	X	X	X	X	X	X	X	X	X	X	X	11/11
3. Interprets Matter-Energy Relations	X	X	X	X	X	X	X	X	X	X	X	11/11
4. Identifies Forces	X	X	X	X	X	X	X	X	X	X	X	11/11
5. Measures Forces	X	X	X	X	X	X	X	X	X	X	X	11/11
6. Solves Density Problems	X	X	X		X	X	X	X		X	X	9/11
7. Conserves Mass, Area & Volume	X	X			X		X		X	X	X	7/11
8. Classifies w/ Several Dichotomies	X	X	X	X	X	X	X	X	X	X	X	11/11
9. Describes Life Requirements	X	X	X	X	X	X	X	X	X	X	X	11/11
10. Compares States of Matter	X	X	X	X	X			X	X	X	X	9/11
11. Cause/Effects on the Environment	X	X		X	X	X		X	X	X	X	9/11
12. Describes Cycles & Phases (Nature)	X	X		X	X	X	X	X	X		X	9/11
13. Infers Weather Cause/Effects	X	X		X		X	X		X	X	X	8/11
14. Models Data	X	X		X	X	X	X	X	X	X	X	10/11
15. Interprets Data	X			X	X		X	X	X	X	X	8/11
16. Describes Cellular Nature of Org.	X	X	X	X	X	X	X	X	X	X	X	11/11
17. Compares Plants and Animals	X	X		X	X		X	X	X	X	X	9/11
18. Interprets the Water, Carbon Dioxide & Nitrogen Cycles		X		X	X	X			X	X	X	7/11
19. Predicts Population Futures	X	X		X	X	X	X	X	X	X	X	10/11
20. Designs Fair Tests for Phenomena		X		X	X	X	X	X	X	X	X	9/11
21. Compares Physical & Chem. Changes	X	X	X	X	X	X	X	X	X	X	X	11/11
22. Interprets Systems, Organs & Tissues	X	X	X	X	X	X	X	X	X	X	X	11/11
23. Infers and Hypothesizes from Data	X	X	X	X	X	X	X	X	X	X	X	11/11

Table 13. SUGGESTED ESSENTIAL MATHEMATICS SKILLS (9-12)

SKILL	GA	TX	IL	WY	NM	NCTM	NCSM	NAEP	GED	CTBS	MAT	TAP	McG	INCLUSION
1. Adds Whole Numbers	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
2. Adds Fractions	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
3. Adds Decimals	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
4. Subtracts Whole Numbers	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
5. Subtracts Decimals	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
6. Subtracts Fractions	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
7. Multiplies Whole Numbers	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
8. Multiplies Decimals	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
9. Divides Whole Numbers	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
10. Divides Decimals	X	X	X	X	X	X	X	X	X	X	X	X	X	13/13
11. Converts Fractions->Decimals	X	X	X	X	X	X	X	X		X	X	X	X	12/13
12. Converts Fractions -> %	X	X	X	X	X	X	X	X		X	X	X	X	12/13
13. Converts Decimals -> %	X	X	X	X	X	X	X	X		X	X	X	X	12/13
14. Measures Perimeter	X	X	X	X	X	X	X	X		X	X	X		11/13
15. Measures Volume	X	X	X	X	X	X	X	X		X	X	X		11/13
16. Measures Area	X	X		X	X	X	X	X		X	X	X		10/13
17. Determines Proportions	X	X		X		X	X	X		X	X	X	X	10/13
18. Measures Temperature	X	X			X	X	X	X		X	X	X	X	10/13
19. Determines Ratios	X	X		X	X	X	X	X		X	X	X		10/13
20. Rounds Numbers	X	X	X	X	X	X	X	X		X		X		10/13
21. Averages Numbers	X	X	X		X	X	X	X		X	X	X		10/13
22. Interprets Data	X	X		X	X	X	X	X			X	X	X	10/13

Table 14. CODING BY VOCATIONAL AREA TO ESSENTIAL SCIENCE SKILLS IN COLORADO

SKILL	Auto Mech	Auto Body	Ind. Arts	Draft.	Const.	Metals	Heal. Occ.	Food Serv	Elec.	Elec-tronec	Comm Art	Graph Arts	Agri. Occ.
1. Describes Atomic Nature of Matter	X	X	X		X	X			X	X			X
2. Describes Forms of Energy	X	X	X		X	X	X		X	X			X
3. Interprets Matter-Energy Relations	X		X		X	X			X	X			X
4. Identifies Forces			X	X					X	X			X
5. Measures Forces			X						X	X			X
6. Solves Density Problems							X						
7. Conserves Mass, Area & Volume													
8. Classifies w/ Several Dichotomies													
9. Describes Life Requirements							X	X					X
10. Compares States of Matter							X	X				X	X
11. Cause/Effects on the Environment							X						X
12. Describes Cycles & Phases (Nature)													X
13. Infers Weather Cause/Effects													
14. Models Data							X		X				X
15. Interprets Data							X		X				X
16. Describes Cellular Nature of Org.							X						X
17. Compares Plants and Animals							X	X					X
18. Interprets the Water, Carbon Dioxide & Nitrogen Cycles													X
19. Predicts Population Futures													X
20. Designs Fair Tests for Phenomena													
21. Compares Physical & Chem. Changes	X		X		X		X	X		X	X		X
22. Interprets Systems, Organs & Tissues							X						X
23. Infers and Hypothesizes from Data													X

Table 15. CODING BY VOCATIONAL AREA TO ESSENTIAL MATHEMATICAL SKILLS

SKILL	Auto Mech	Auto Body	Ind. Arts	Draft.	Const.	Metals	Heal. Occ.	Food Serv	Elec.	Elec-tromec	Comm Art	Graph Arts	Agri. Occ.
1. Adds Whole Numbers	X	X	X	X	X	X	X	X	X	X	X	X	X
2. Adds Fractions	X	X	X	X	X		X	X	X	X			X
3. Adds Decimals	X	X	X	X	X	X	X	X	X	X	X	X	X
4. Subtracts Whole Numbers	X	X	X	X	X	X	X	X	X	X	X	X	X
5. Subtracts Decimals	X	X	X	X	X	X	X	X	X	X	X	X	X
6. Subtracts Fractions	X				X		X	X	X	X			X
7. Multiplies Whole Numbers	X	X	X	X	X	X	X	X	X	X	X	X	X
8. Multiplies Decimals	X	X	X	X	X	X	X	X	X	X	X	X	X
9. Divides Whole Numbers	X	X	X	X	X	X	X	X	X	X	X	X	X
10. Divides Decimals	X	X	X	X	X	X	X	X	X	X	X	X	X
11. Converts Fractions->Decimals	X												
12. Converts Fractions -> %	X						X	X					
13. Converts Decimals -> %	X				X		X	X			X		X
14. Measures Perimeter	X		X		X	X				X			X
15. Measures Volume	X		X		X	X				X			X
16. Measures Area	X	X	X		X	X		X		X	X		X
17. Determines Proportions				X	X		X				X	X	
18. Measures Temperature	X						X	X	X				X
19. Determines Ratios	X			X	X	X					X	X	
20. Rounds Numbers													
21. Averages Numbers		X	X		X								X
22. Interprets Data			X				X		X				X

APPENDIX F

SUGGESTED ALTERNATIVE MODELS

SUGGESTED MODELS RELATED TO SCIENCE AND MATHEMATICS CREDIT REQUIREMENTS

INTRODUCTION

The models suggested here are presented as ways to lessen the impact and competition of increased course requirements in science and mathematics. Some care has been taken to avoid the following:

-Awarding dual credit in an academic area and vocational area for the same time allotment.

-Indication that additional courses are unimportant and that schools should stress only one area.

-Indication that experience in vocational courses alone will meet all the requirements of science and mathematics students.

The models are based on the suggested essential skills identified in this study. These skills are taught in introductory courses of chemistry, physics and biology. The essential mathematics skills would be completed by the time students complete Algebra I for the most part. They must be considered as minimal in the academic areas.

If the skills are "essential" as many educators believe, there is certainly less need to add more course requirements in science and mathematics. Where these skills are coded to applied areas like vocational education, there is even more assurance that these skills are being applied and maintained. The models offer diversity and several options for the local education agencies to consider. The need for a balanced comprehensive high school program should be emphasized.

OPTION 1 - Direct Credit for Vocational Courses

Examples:

A. Science Courses

1. Principles to Technology
2. Electronics
3. Electromechanics
4. Health Occupations

B. Mathematics Courses

1. Business Mathematics
2. Accounting
3. Math of Finance Industry
4. Consumer Mathematics

OPTION 2 - Shared Credits for Vocational Courses (1/2 Academic - 1/2 Vocational)

Examples

A. Science Courses

1. Combination of any two of these courses for a combined 1 unit in science and 1/2 unit in each of the two vocational courses.

a. Electronics
b. Electromechanics
c. Vocational Agriculture
d. Horticulture
e. Automechanics
f. Health Occupations
g. Industrial Arts

B. Mathematics Courses

1. Combination of any two of these courses for a combined 1 unit in mathematics and 1/2 unit in each of the two vocational courses.

a. Auto Mechanics
b. Construction
c. Electronics
d. Electromechanics
e. Metals
f. Health Occupations
g. Commercial Art
h. Industrial Art

OPTION 3 - Competency testing in lieu of credits required:

Using suggested essential skills tests to establish competency at that level so that one or both courses could be deleted or reduced.

OPTION 4 - Request policy change at the local district to reduce established credit requirements based on the coded skills, tests, demonstrated occupational needs for students, national trends, state trends and requirements. The codings, tests and trends give local educators some outside support for this position.

OPTION 5 - Adoption or adaptation of a successful model from exemplary programs in other districts. These need to be identified and made available.